SUPPLEMENT.

The Mining Journal,

RAILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

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ON SLATE AND SLATE QUARRIES.

BY S. R. PATTISON, F.G.S.

Chapter IV.—Slate Enterprise and Trade.

The future of slate quarrying is governed by two considerations. First, it is obvious that the veins of productive slate are so numerous and extensive as to remove all fear of any general deficiency of supply, even from North Wales, where the most exhaustive works are carried on, in any appreciable duration of time. The slate deposits in other countries remain as reserves, which will outweigh the consumption from present demand for generations to come. Secondly, the progress of discovery and profitable working must, in the nature of things, be gradual and progressive. Actual experiment is necessary, requiring time for its accomplishment. The numerous failures incidental to all mineral enterprise will always retard the development of slate industry, so that the builders' demand arising from new construction and repairs has hitherto been constantly gaining on supply.

There is no constant official record of the amount of slate production in England and Wales. Mr. Hunt computes it as follows:—

North Wales	Tons 352,700	The whole may be estimated at 2*l.* 10*s.* per ton, or a total of, say, 100,000*l.* per annum.
Delabole district, Cornwall	17,050	
Devonshire quarries	15,000	
Lancashire and Cumberland	3,500	

The Welsh supply, taken at 350,000 tons per annum, may be distributed as follows:—

Festiniog and surrounding veins	Tons 98,000
Penrhyn and surrounding veins	109,000
Llanberis veins	75,000
Nantlle	40,000
Corris veins	20,000
Making a total of	Tons 342,000

The number of hands employed, including shippers, men on new works, and all about the quarries, or dependent on quarrying, is estimated at 9400. Of this total the Festiniog veins employ 2900, Penrhyn 2500, Llanberis 2000, Nantlle 1300, and Corris 700.

The consumption of slate in London is about 60,000 tons per annum, of which one-third is in slabs, and the rest in roofing slates. Of the latter there are nine sizes. Roofing slates are sold at so much per thousand, and slabs at so much per foot, but in exceptional cases both are sold by the ton. The price is regulated by a periodical "list," issued by the Penrhyn and Dinorwic Quarries jointly.

The use of slate for roofing appears to have been unknown to the ancients. We learn from Pliny that the roofs in Rome were covered with boards, afterwards with thatch, then by beaten earth, finally by tiles of burnt clay, or plates of metal.

The employment of slates commenced near the centres of production, North Wales and Angers, in which localities they may be traced to an earlier period than elsewhere. The first workings were on the outcrop of the beds, then they were followed by shallow excavations, to which for many centuries slate quarrying was confined. The castle at Angers, erected in the days of our Plantagenets, shows the use of slate in the original building, as do many of the old fortresses of Wales. Its advantages could not fail to occur to the able architects of the twelfth and thirteenth centuries.

There are two elements of uncertainty existing in slate quarry enterprise, which are the sources of fraud, mistake, and disappointment. The one is the variable proportion which the actual productive slate bears to the whole rock mass, and the other the actual cost of slate making. The former may be diminished by the knowledge of experienced, impartial surveyors; the latter can only be done away with by the total abandonment of the poundage allowed to the slate makers, in addition to their contracts. The latter will be treated of in another chapter, the former belongs to this.

Slate is contained in veins; veins are not composed of slates, but of slate rock, from which the slate blocks are extracted. We may disregard the waste of the actual cutting and squaring into slates, but we must not disregard the waste of rock in the slate vein, as is often done for delusive purposes. A slate vein will be called pure and paying if it yields one-fourth of its total mass in blocks. So that three-fourths even of the vein is worthless rubble, and the actual slate must pay for the winning and removal of three-fourths of its own weight in the vein itself. The question which it is difficult, if not impracticable, to get answered in Wales, in ordinary cases, is what is the worth of the vein—*i.e.*, what proportion does the marketable product bear to the whole vein? This varies, even in paying quarries, from 1 in 12 to 1 in 25. The cost also varies with the direction of the ground in regard to the bedding and strike of the rock, and in regard to the facilities for water power and rubble ground, and the occurrence of hard dyke veins, or posts. But it is quite capable of being approximately ascertained. It is the same experiment that a railway contractor has to make in contracting for any earthwork. The rock can be measured, the weight of its contents ascertained, and under given conditions the cost ascertained. The next thing to be ascertained is the proportion of "head," or totally unproductive rock which must be removed before the vein is exposed to work. The expense of opening is not like that of removing the unprofitable part of the vein, a constantly recurring expense, but one which is occasional only, and which when done uncovers a portion of slate vein on which work can be done for some time. The position and slant of the vein determines for how long the uncovering will serve; this may be also approximately calculated on by any surveyor acquainted with the subject. Unwary persons are taken in by the statement that this "cost of development," as it is called, is done once for all, instead of periodically recurring as the vein is wrought; and then by the representation implied, that what is reached when this has taken place is pure slate, instead of its being only a slate vein, with one-fourth or a less proportion of actual slates. It will be at once seen that these two variable proportions—viz., that of the actual slate to the vein, and that of the vein to the mountain—may be in the minds of sanguine or partially informed persons, or in the hands of knaves, most fertile sources of mischief. When slate has been reached the first care should be to test the vein itself, to mark off a certain portion, and insist on a separate account of the cost of its extraction, and then an accurate statement of the whole of its contents, so as to ascertain what profit it would yield if exposed and worked. The effort at this stage will be to make out that the vein is too near the surface to yield a fair result, or to take off cost connected with it, under the pretext of cost of development. These must not be yielded to. If a result cannot be obtained, or if when obtained it is not largely productive, the enterprise should be abandoned. But if the slate vein promises to yield a fair profit, then there comes the important calculation of the expenses of getting at it, what they will amount to, and whether they ought to be distributed over seven or less years. Whatever they are, they must be added in some way to the cost of the vein-work, and then the result ascertained. Estimates based on separate calculations of these two separate processes should be insisted on. The absence of them is detrimental to the permanent employment of foreign capital in this great commercial enterprise.

Chapter V.—Manufacture and Sale.

Slate making is divisible into four stages—first, the detaching the blocks of stone from the vein, and getting them to the floor or level; secondly, dividing the blocks, and removing them to the manufacturing sheds; thirdly, sawing one edge; fourthly, cleaving the blocks into slates. These four operations are carried on by contract; they together constitute the work of a "bargain;" which is a contract to produce manufactured slates from a given area of rock at so much per thousand. The contracts are let by the manager, not by survey, the kind or auction used in the Cornish mining system, but by the valuation of the manager. The contractors employ their own labourers to remove the rock, the rubble, and the slate. They are successful, of course, in exact proportion to their skill in ascertaining beforehand the character of the rock, and in afterwards working with the least expenditure of powder, tools, and labour. They must also be small capitalists, in order to keep up the pay of labourers, and to bear the misfortune of a possibly bad bargain. From the necessity of these qualities has sprung up the cultivation of habits of observation and thrift. It is the ambition of a young quarry labourer to become a "bargain-man," whilst an unfortunate foreman of the latter class has sometimes, from ill judgment or improvidence, to resume work as a labourer. The contractor furnishes tools, repairs, and powder, and has the use of machinery for trimming the slates, where adopted, at a fixed rate.

The fragment of rock is lifted from its bed and thrown on to the working level, rudely cleaved into thicknesses of about 2 or 3 inches by the crowbar, then broken across the grain into pieces suitable for slate making, and in this stage called a block. The blocks are then again divided transversely into roughly approximate slate size, by cutting a groove with chisel and mallet and breaking them across, or by the use of the cross-cutting saw driven by machinery. The latter has the additional advantage of furnishing one even edge for the future slate. It is then cleft with mallet and chisel, and next reduced to the regulation size which it will best make. This is done either by hand or by a simple but ingenious and effective bowstring or spring chopping machine. The slate maker ranges it with his pile of "firsts" or "seconds," as the case may be, and his labourer piles them away for counting and removal. Slates are thus finished and fit for sale within a few minutes of the time the raw material leaves its native bed. The slate cleaves better when fresh from the quarry than after exposure. A slight frost aids the cleavage, a thaw obstructs it, fresh frost again facilitates, but a succession of frost and thaw repeated, renders the block refractory. Practically, the blocks are cleft immediately after being raised, the two operations go on simultaneously. The bargains in all inferior or young quarries, or coarse or doubtful parts of the vein, are accompanied by a stipulation for poundage to be made up by the owner, so as to secure a minimum living rate of wages. The quarry owners receive the slates from the bargainers, and then are, of course, responsible for their storage and sale.

The carriage to the wharf or port of shipment is, of course, the work of the owners. It is usually made the subject of a contract. If the distance to be traversed is considerable, the cost of horse power and the breakages, soon arrive at a point which determines the construction of a tramroad between the quarry and the market, or the place of sale.

Prof. J. E. Cairns, in an interesting article contributed by him to a periodical publication in 1865, entitled "Co-operation in the Slate Quarries of North Wales," thus claims for this system of bargains the merit of solving the problem of the proper relation between the operative and the master, between capital and labour, one of the most important and pressing questions of our time. He says:—

"I think it will be seen at once that this 'contract system' constitutes a true case of 'co-operation.' It is, at least, certain that it fulfils what I venture to think are the most important conditions of that method of industry. There is associated effort; there is common interest in the results of the work; and these results depend, subject to the natural conditions of the case, and the customary qualification of the strict contract just indicated, directly on the energy, skill, and mutual good faith with which the workers perform their part. It has also been said that the 'contractors' advance a portion of the capital; but I should not be disposed to attach much importance to this as a distinctive feature of the 'contract system;' for though, as a matter of fact, the men who take part in contracts have generally accumulated some little capital, and though this circumstance no doubt facilitates in some degree their proceedings in carrying out the undertaking, still the possession of capital does not by any means constitute an indispensable condition to becoming a contractor, it being always easy for a man of good character to obtain the requisite tools and materials on credit from small shopkeepers established in the quarrying districts, and established chiefly with a view to supplying such needs. The only item of capital which in practice the contractor is in the habit of advancing is the money expended on his own support during the monthly interval that elapses before the returns to his industry come in; and, so far as this is concerned, the 'germyn' whom he employs—a labourer at fixed wages—has an equally valid title to take rank as a capitalist; the earnings of the 'germyn' being also postponed for the same period of time. The value of the experiment, therefore, and that which entitles it to be regarded as an example of 'co-operative' industry, lies, in my opinion, in the other conditions to which I have referred—in the fact that the system enlists working men in a joint undertaking, of which the results for them depend in large part on the skill, energy, and conscientious zeal with which it is carried through.

"And now let us endeavour to appreciate the bearing of these conditions on the well being of the quarrying community. We shall consider, in the first place, the position of the contractor, who, as I have already said, represents about a third of the whole quarrying population. He will not, of course, for a moment be confounded with the important and generally wealthy personage by whom our railways and great public works are carried on. The latter, a capitalist pure and simple, has no other relations with the actual workers than that of paymaster. But the contractor of the slate quarries is himself a manual worker—generally, indeed, a skilled worker, taking to himself the more difficult processes of the undertaking, but still in the strictest sense a working man, working in the same place, and often at the same operation, as the labourer whom he employs, and socially in no respect his superior. But, though a manual labourer, our contractor is also something very different from the ordinary labourer for hire. His remuneration is no fixed sum, but depends upon the success of his exertions, which he has, therefore, the strongest interest to increase to the utmost. Nor, again, is he to be confounded with the labourer at task-work. In the first place, the undertaking in which he embarks is of an altogether more important character than any that falls to the lot of the ordinary task-work labourer. Before he commits himself to his engagements, a calculation not altogether free from complication—requiring, besides an acquaintance with arithmetic, and a tincture of mathematics, some practical knowledge of the different qualities of certain rocks—must be performed. Then, the undertaking itself comprises several distinct operations—quarrying, cleaving, dressing—the carrying out of which, effectively and economically, calls for deliberation, forethought, and organising skill.

"Again, the contractor, while a labourer himself, is also a purchaser of the labour of others, holding towards his 'germyn' the position of capitalist proper, and is thus led to look at the business of production in some degree from the point of view of an employer, a circumstance which may go some way in accounting for the noteworthy fact that in the districts of the slate quarries strikes are unknown. Lastly, and to this I attach the greatest importance of all, the contractor is a member of a partnership acquiring rights, and incurring responsibilities in relation to his fellow-contractors, taking part in their labours on equal terms, sharing their anxieties, and interested in common with them in the ultimate result of their common efforts.

"But the influence of the arrangements I have described is not limited to the class which comes immediately under their operation. A circumstance which gives especial importance to the status of the contractor in the slate quarry is that, placed as nearly as possible midway between the position of the ordinary labourer and that of the capitalist pure and simple, it forms an easy stepping-stone for the elevation of the masses from the precarious position of dependence upon the general labour market—a position which, if there be value in experience, is absolutely incompatible with any substantial and permanent improvement of their state.

"Thus the labourers who have not yet attained to the rank of contractors are ever working in full view of an early promotion to this position, their attainment of which, however, depends entirely on their success in recommending themselves to the favourable consideration of the owner of the quarry as well to that—an equally important condition—of their own fellow-workmen, without whose approval and co-operation they would hope in vain to take advantage of the opportunities which are daily opening. Even the less important class of workmen, they who are employed in clearing away refuse, also pass occasionally into the ranks of the quarries proper, and ultimately into those of the contractors, and thus feel in some degree the stimulus which such prospects supply. The whole society is thus kept constantly under the incentive of the public opinion of the *élite* among its own members—a state of things which serves to diffuse throughout the entire organisation an influence of the healthiest kind.

"Such, then, is the 'contract system' of the slate quarries, and such are its fruits. Divested, as it is, of certain extraneous advantages which accompany other forms of 'co-operation,' it sets, as it seems to me, in all the stronger light the inherent virtue of the principle itself—the principle of combining the exertions of labourers towards a common result in which they have a joint interest—an interest varying with the success of their common efforts. The results here obtained are obtained not so much through the increased force of the external inducements to prudent or righteous conduct as by strengthening the character of the workman, calling into action qualities of mind which in the ordinary condition of the labourer's life lie dormant, enlarging his mental horizon, stimulating his reflective powers, widening his sympathies—in a word, developing those principles and habits which furnish the only solid basis for any permanent improvement of his state."

Conclusion.

The slowness, and yet average steadiness, of the progress of the realisation of mineral substances from the earth's crust is a remarkable fact. It is due to the peculiar arrangement whereby minerals have been disseminated throughout the mass, not in large aggregations, so as to centralise the products, nor in fine subdivision, so as to disperse them universally, but in lines of deposit requiring discovery, and the succession and continuous application of labour and skill for extraction. Slate, for instance, is so deposited throughout the world as to require and reward the efforts of invention and industry as it is needed by the progress of population and the arts. Yet, in spite of the application of skilled labour, there are constant failures in its pursuit, such failures, however, becoming diminished just in proportion as accurate knowledge is brought to bear on the subject. Occasional failures from unforeseen contingencies will, to some extent, always remain a condition of the problem. The converse, too, must be true—namely, larger successes than the average. Viewing the subject in its moral aspect, it is difficult to avoid the conclusion that this state of things is best fitted for the development and regulation of the faculties of man as he is. The law of continuation, of connection in phenomena, which links together so large a proportion of existing things, does not end there, but extends from physical to moral and spiritual, and binds all things to the will of the Supreme.

THE BRITISH ASSOCIATION.

Thirty-Ninth Anniversary, at Exeter, August, 1869.

REPORT ON MINERAL VEINS IN CARBONIFEROUS LIMESTONE, AND THEIR ORGANIC CONTENTS.

BY CHARLES MOORE, F.G.S.

The relative ages of rocks has long ago been known from the study of their organic remains, but few geologists ever expected that the ages of mineral veins would become known by the fossils which had been dropped into them when they existed as open fissures connected with the sea bottom. This, however, was the purport of Mr. Moore's report in the Geological Section, and everybody seemed surprised by the careful statement of his numerous facts. Mr. Moore has for a long time made the phenomena attending mineral veins, and the organic remains he has detected in them, his special study. In his paper he first referred to the prevalent ideas that were entertained as to the origin of minerals in veins, some supposing them to be due to sublimation, others to segregation. In the first instance it is believed that they are derived from the passage upwards through the veins of vapours holding the minerals from the heated interior of the earth; in the latter, that they have been extracted from and drawn together from the matrix forming the walls of the veins, and re-deposited therein. The difficulties attending both these popular ideas were then noticed. Referring to Mr. Wallace's theory that many of the veins had been filled, and the minerals segregated by atmospheric and hydrous agency from the circulation through them of large bodies of water since the glacial period, he pointed out that in this case the organic remains in the veins would be comparatively recent, and that the remote age of all the fossils he had found was against it. Mr. Moore's view was that the mineral veins were at first open fissures, in immediate connection with and filled with the waters of the ocean, and that there would be necessary for the subsequent deposition of the minerals therein the presence of certain minerals in the ancient seas, favourable electrical conditions, and time for their precipitation; and it was stated to be an established fact that the minerals now found in veins are known to be present in solution in the waters of the ocean. The organic remains he had discovered were strongly confirmatory of his view, and the age of different mineral veins could be determined by their presence. Thus, on the Mendips liassic fish and testacea in the veins proved the minerals of that district, although enclosed in walls of carboniferous limestone, to be as young as the lias, although no liassic rocks are to be found for several miles, and in the North of England some of the veins were shown to be subsequent to the coal period.

The organic remains which were described at length by Mr. Moore were of the most varied kinds—*Flemingites gracilis*, a small coniferous seed of the coal measures, had been found in several mines. *Conodonts*, never before observed above Silurian strata, were very minute bodies, not unlike fish jaws and spines, but which were supposed to be either teeth or spines of nudibranchiate mollusca, occurred in the veins in considerable numbers, presenting a most remarkable series of forms, and *Entomostraca* of the genera *Bairdia*, *Beyrechia*, *Cythere*, *Cytherella*, *Kirkbia*, and *Moorea* of about 30 species. *Foraminifera*, representing five genera, were abundant, the chief interest attaching to *Involutina*, of which until lately only one species from the lias was known, but of which Mr. Moore had found 11 species. Of this class he had obtained from the lead veins species of *Dentalina*, *Textularia*, and *Tinoporus*, which had lived on from the palæozoic age to the present time. Not the least important of his mine explorations had been the discovery of a land and fresh water fauna. Until lately the only known terrestrial shell below the secondary beds was the *Pupa vetusta*, found by Sir Charles Lyell and Dr. Dawson in the coal beds of Nova Scotia, but he had now nine genera of land and fresh water shells from the lead mines of this country, all of them probably of carboniferous limestone age. These include *Helix*, *Vertigo*, and *Proserpina*, land shells from the Mendip mines, as well as the fresh water genera of *Planorbis* and *Valvata*, to which, from the North

of England mines, are to be added those of *Hydrobia, Bythinia, Lithoglyphus,* and *Pisidium*. Fish remains were often found Under these peculiar circumstances, from mineral veins and fissures of different ages in the carboniferous limestone, he had discovered the oldest known mammalia, about 8 genera of reptilia and 32 of fish, the oldest land and fresh water mollusca, and numerous other remains, numbering in the whole about 267 species.

Mr. H. B. BRADY, who had made a special study of the Foraminifera discovered by Mr. Moore, referred to the great interest attaching to the genus *Involutina* from the remarkable variety of form they presented, which had not hitherto been recognised in connection with the genus.

The PRESIDENT called on Mr. Enys, a practical mineral proprietor from Cornwall, to say something on the speculative views advanced by Mr. Moore, who remarked that hitherto he had supposed they knew something of the formation of mineral veins, but the facts adduced by Mr. Moore were so remarkable that he could not controvert them, and he considered the subject one of the most important that had come before the Geological Section.

Prof. PHILLIPS said Mr. Moore had produced so many new facts he was entitled to speculate. He was not content with the ordinary line of geological investigation, but delighted in working out phenomena which were overlooked by other geologists. When he first heard of Mr. Moore's discoveries he was perfectly astonished. Mr. Brady's remarks on the alterations in the types of certain of the Foraminifera were interesting and valuable.

MECHANICAL SCIENCE.—Mr. C. W. Siemens, in his inaugural address, said—While science and mechanical skill are combined to produce such wondrous results, the germs of further and still greater achievements are matured in our mechanical workshops, in our forges and in our metallurgical smelting-works. Here a great revolution of our constructive art has been prepared by the production, in large quantities and at moderate cost, of a material of more than twice the strength of iron, which, instead of being fibrous, has its full strength in every direction, and which can be modulated to every degree of ductility, approaching the hardness of the diamond on the one hand and the proverbial toughness of leather on the other. To call this material cast-steel seems to attribute to it brittleness and uncertainty of temper, which, however, are not its necessary characteristics. This new material, as prepared for constructive purposes, may indeed be both hard and tough, as is illustrated by the hard steel rope that has so materially contributed to the practical success of steam ploughing. Machinery-steel has gradually come into use since about 1850, when Krupp (of Essen) commenced to supply large ingots, that were shaped into railway tyres, axles, cannon, &c., by melting steel in halls containing hundreds of melting crucibles. The Bessemer process, in dispensing with the process of puddling, and in utilising the carbon contained in the pig-iron, to effect the fusion of the final metal, has given a vast extension to the application of cast-steel for railway bars, tyres, boiler plates, &c. This process is limited, however, in its application to superior brands of pig-iron, containing much carbon and no sulphur or phosphorus, which latter impurities are so destructive to the qualities of steel. The puddling process has still to be resorted to, unless the process of decarburisation by Mr. Heaton takes its place, to purify those inferior pig-irons which constitute the bulk of our production; and the puddled iron cannot be brought to the condition of cast-steel except through the process of fusion. This fusion is accomplished successfully in masses of from 3 to 5 tons, on the open bed of a regenerative gas furnace, at the Landore Siemens Steel-works, and at other places. At the same works cast-steel is also produced, to a limited extent as yet, from iron ore, which being operated upon in large masses, is reduced to the metallic state and liquefied by the aid of a certain proportion of pig metal. The regenerative gas furnace, the application of which to glass-houses, to forges, &c., has made considerable progress, is well suited for these operations, because it combines an intensity of heat, limited only by the point of fusion of the most refractory material, with extreme mildness of draught and chemical neutrality of flame. These and other processes of recent origin, tend towards the production, at a comparatively cheap rate of a high-class material, that must supersede iron for almost all structural purposes. As yet engineers hesitate, and very properly so, to construct their bridges, their vessels, and their rolling stock of the material produced by these processes, because no exhaustive experiments have been published as yet, fixing the limit to which they may safely be loaded in extension, in compression, and in torsion, and because, as yet, no sufficient information has been obtained regarding the tests by which their quality can best be ascertained. This want is in the way of being supplied by the experimental researches that have been carried on for some time at the dockyards at Woolwich; the results of Mr. Whitworth's experiments tending to render the hammer and the rolls obsolete by forcing cast-steel, while in a semi-fluid state, into strong iron moulds by hydraulic pressure, are looked upon with great interest. But, assuming that the new building material has been reduced to the utmost degree of uniformity and cheapness, and that its limits of strength are ascertained, there remains still the task for the civil and mechanical engineer to prepare designs suitable for the development of its peculiar qualities. In constructing works in foreign parts the reduced cost of carriage furnishes also a powerful argument in favour of the stronger material, although its first cost per ton might largely exceed that of iron. The enquiries of the Royal Coal Commission into the extent and management of our coal fields appear to be re-assuring as regards the danger of their becoming soon exhausted. Nevertheless the importance of economising these precious deposits in the production of steam-power, in metallurgical operations, and in domestic use, can hardly be over estimated. The calorific power residing in a pound of coal, of a given analysis, can now be accurately expressed in units of heat, which, again, are represented by equivalent units of force or of chemical action; therefore, if we ascertain the consumption of coal of a steam-engine or of a furnace employed in metallurgical operations, we are able to tell, by the light of physical science, what proportion of the heat of combustion is utilised and what proportion is lost. Having arrived at this point, we can also trace the channels through which loss takes place, and in diminishing these by judicious improvement we shall more and more approach those standards of ultimate perfection which we can never reach, but which we should nevertheless keep steadfastly before our eyes. Thus a pound of ordinary coal is capable of producing 12,000 (Fahrenheit) units of heat, which equal 2,240,000 foot-lbs. or units of force, whereas the very best performances of our pumping-engines do not exceed the limit of 1,000,000 foot-lbs. of force per pound of coal consumed. In like manner 1 lb. of coal should be capable of heating 33 lb of iron to the welding point (of say 3000° Fahr.), whereas, in an ordinary furnace, not 2 lb. of iron are so heated with 1 lb. of coal. These figures show the field for further improvement that lies yet before us. Although heat may be said to be the moving principle by which all things in nature are accomplished, an excess of it is not only hurtful to some of our processes, such as brewing, and destructive to our nutriments, but to those living in hot climates or sitting in crowded room, an excess of temperature is as great a source of discomfort as excessive cold can be. Why, then, should we not resort to refrigeration in summer as well as to calorification in winter, if it can be shown that the one can be done at nearly the same cost as the other? So long as we rely for refrigeration upon our ice-cellars, or upon importation of ice from distant parts, we shall have to look upon refrigeration as a costly luxury only; but the President expresses his belief that by the use of properly constructed machines it will be possible to produce refrigeration at an extremely moderate expenditure of fuel and labour. A machine has already been constructed capable of producing 9 lbs. of ice (or its equivalent) for 1 lb. of coal, whereas the equivalent values of positive heat developed in the combustion of 1 lb. of coal, and of negative heat residing in 1 lb. of ice, is about as 12,000 to 170, or as 70 to 1. This result justifies the employment of refrigerating machines upon a large scale; but it is hard to say what results may yet be reached with an improved machine on strictly dynamical principles, because such a machine seems not tied in its results to any definite theoretical limits. In changing, for example, a pound of water from the liquid into the gaseous state, a given number of units of heat are required, that may be produced by combustion of coal or by the expenditure of force; but in changing the same pound of water into ice, heat is not lost but gained in the operation, which heat must be traceable to another part of the machine, either as sensible heat or as developed force.

IMPROVEMENTS IN OBTAINING MOTIVE POWER.—The arrangement referred to in the paper read before the British Association by Mr. Richard Eaton related to a combined air and steam engine, invented by Mr. GEORGE WARSOP, of Nottingham. In the first attempts at practically carrying out the system the arrangement adopted was that of an ordinary high-pressure engine, with vertical boiler, as used in the Midland Counties, where fuel is cheap. An air-pump is added, which is put in operation by the action of the steam-engine. Thus cold air is taken by the air-pump, and is forced on, in its compressed state, through an air-pipe; which, in the case before us, is conducted first within the exhaust, then in a coiled form, down the funnel of the boiler, then past the fire, and finally, past a self-acting clack-valve at the bottom of the boiler into the boiling water itself. Rising naturally through the water, the air is intercepted and subdivided by diaphragms of metal gauze; thus a twofold service is rendered by the contact of the elements, the water aerified and deprived of its cohesion, and prompted to a freer ebullition, whilst the air on rising above the water is saturated by the steam, and the two together pass on to their duty in the cylinder, where the saturation assists lubrication. The agitation of the water prevents scaling. The machine thus constructed, but having two air-pumps with cam motions applied to the valves, as also to the poppet-valves of the working cylinder, gave excellent results, the percentage of gain in work done by the combined engine as compared with that done by steam only was 28 per cent. in the open valve trial, the damper being wide open throughout, and 47 per cent. in the even pressure trial, damper varied. The latter trial was conducted on the same principle as that followed by the Royal Agricultural Society—the engine being stopped in each case when it ceased to perform 90 revolutions per minute.

DRYING AND CARBONISING PEAT.—The invention of Mr. J. J. HAYS, King's Cross, relates to improved machinery or apparatus for getting peat from the bog, to improved machinery for working and drying peat for fuel, and to improved modes of carbonising peat. The machine employed for digging or getting peat from the bog consists of a drum fixed to a proper framing, and caused to rotate by means of a portable engine, attached to the machine, though it may be separate therefrom. The drums are formed with inclined cutting segments, that pare down the peat in thin strips or layers, which fall into the interior of the drum, and are there triturated and thrown out on to endless bands or otherwise, by rapidly-revolving arms rotating round the axis of the drum, but at a greater speed.

NEW EXPLOSIVE.—Mr. PERCY A. BLAKE, of Highbury, has just patented a new or improved safety explosive compound or compounds to be used for blasting and other purposes, together with means connected with its use.

The NEW VADE MECUM (invented and manufactured by Charles H. Vincent, optician, of 23, Windsor-street, Liverpool) consists of a telescope well adapted for tourists, &c., to which is added an excellent microscope of great power and first-class definition, quite equal to others sold at ten times the price. Wonderful as it may seem, the price of this ingenious combination is only 3s. 6d., and Mr. Vincent sends it (carriage free) anywhere, with printed directions, upon receipt of Post Office order, or stamps, to the amount of 3s. 10d.

Original Correspondence.

RECENT IMPROVEMENTS IN COAL MINING.

SIR,—We naturally expect improvements in relation to mining to keep pace with those of other industries. Notwithstanding they have been adopted to a great extent, we are surprised at the accidents still occurring in our coal mines, and this may be accounted for by saying that known improvements are not so generally adopted as they ought to be, or that further knowledge is required in order to place the working of mines on a safe and healthy basis. The Powell Duffryn Collieries may be taken as an instance of the successful application of modern methods of working and bringing coal to the surface, and the necessary operations in connection with them.

LOWER DUFFRYN PITS.—These are about 500 yards apart, and both used in raising coal. The upper pit, in addition to being used for coal drawing, it should have been stated in my former letter, is also the return air-pit to the two Guibal fans; these are placed about 20 yards from the top of the pit, having a space of 18 ft. between them. Each fan is driven by a vertical direct-action engine, 24 in. cylinder, 2 ft. stroke; each fan has a separate passage of communication with the pit, just below the surface. The arrangement for making the top of the pit air-tight is by a wooden framework the required height for the carriages to work in, two holes in the top for the ropes to run through, and four close doors. Each carriage in coming to its position at the top of the pit raises two doors, one on each side, to allow the trams to be changed; the doors descend immediately with the carriage, and close the top of the pit. While the carriage is at the top, resting on the catches, the bottom of it is made to fit as close as possible to the aperture left for each carriage to work through, but this cannot be made so effectual to prevent the passage of air as when the doors are closed.

MIDDLE DUFFRYN PITS.—One pit is used for raising coal, and one pit for pumping; the latter, closed at top, forms the return air-pit to the Guibal fan. The coal from the Six-feet and Nine-feet seams is hauled up a stone drift, rising 6 inches per yard, to the Four-feet seam, near the shaft. The drift is driven north across the measures 300 yards to the Nine-feet, and about 150 yards to the Five-feet. The hauling engine is on the surface. The whole of the produce of the two seams is drawn up this drift, and also up the shaft. There is a branch siding on each side of the drift at the Six-feet seam, and similar sidings at the foot of the drift in the Nine-feet seam.

COMPRESSED-AIR ENGINES.—Having before given an outline of these engines, I now furnish the details of their mode of working. No. 1 engine is placed in the east branch of the Six-feet seam, about 30 yards from the drift; cylinders 9 in. diameter, 18 in. stroke, 40 lbs. air pressure, two drums 4 ft. diameter, cog-wheels 1 ft. and 5 ft. diameter. This engine draws laden trams from two ways; one drum draws up the south plane, 700 yards in length, rising 3 inches per yard, five trams at once, into the siding; the empty trams run down with the rope. The other drum draws the laden trams along the west level, 650 yards long; 12 trams or more are run at once, speed five miles per hour. This level was not designed for an engine, and follows the irregular level course; it is, therefore, not well adapted for the ropes and the running of trains. At the west end of this plane No. 3 engine is placed, which is used for the purpose of drawing the empty trams in; the two cylinders are 6 inches diameter, 12 inches stroke, cog-wheels 1 ft. and 5 ft. diameter, one drum 4 ft. diameter; another drum is ready to be applied to draw from the dip of this engine. No. 4 engine is of the same dimensions as No. 3; it is placed near the top of a cross heading, which commences near No. 3 engine, and extends 600 yards northward; it takes hold of the trams from No. 3 siding, and draws them up the cross heading; the laden ones run down with the rope to the full siding; only one drum is in use; another can be applied. No. 2 engine is placed in the Nine-feet seam, about 30 yards north-east from the bottom of the stone drift; it is of the same dimensions as No. 1 engine, and draws eight or more trams at once up the south incline, a little past the siding, and drops them back into it; the empty trams are worked *vice versa*, and run down by gravity with the rope; the plane is 350 yards in length to the bottom, but there are branches east and west 250 yards down; one drum only is used; the engine is provided with another for any extension of work. Each engine is placed on a light wooden framework; it can be moved and fixed in another position in two days. The drums are put in and out of gear by clutches. The ropes are $\frac{5}{8}$ in. steel wire. The pressure of air is usually 40 lbs. per square inch at the engines, and the same in the engine-house on the surface. Each engine has two horizontal cylinders. The air pipes down the pit to the receiver are 6 in. diameter; 6 in. pipes are laid from the receiver to No. 1 engine, 200 yards length; 4 in. pipes from these to No. 2 engine, in the Nine-feet seam, 200 yards further; 4 in. metal pipes from the receiver to No. 3 engine, 850 yards length; and 2 in. pipes from No. 3 to No. 4 engine, 600 yards further.

MODE OF WORKING THE SIX-FEET SEAM.—The coal is got by the long wall process. The gate-roads are 14 yards apart. Section of seam—Inferior coal, 6 in. thrown to gob; shale, 1 to 2 in. thrown to gob; good coal, 3 ft. 2 in.=3 ft. 9 in.; fire-clay or clod. The section given above is the lowest part of the mine, in other parts of the mine the thickness of good coal is 4 ft. 6 in. About 1 ft. of the fire-clay is taken up, and 2 ft. of the top taken down in the gate-roads; this and the small coal is cast into the gob; after the stalls are finished the gate-roads are filled up close with debris. The coal sticks sometimes either at the top or the bottom, and it is then difficult to get it down without using powder; this is used occasionally here, and Mr. Chubb's coal-breaker has been introduced into the Six-feet, which I had an opportunity of seeing at work. This coal does not seem to be well adapted for obtaining good results from this machine, owing to the occurrence of backs and riders frequently. A hole was bored 3 ft. 8 in. in, and above 5 in. diameter, but owing to a rider intervening the full effect was not obtained, and about 1 ton of coal only broke down. Two men drill the hole, but it is too laborious for them to work continuously at it; it will, probably, take three men to drill a 4-ft. hole in 20 minutes. The area of eight pistons is 39 in., at 3 tons per inch the force would be 117 tons on the side of the cover. In a seam of coal less subject to backs and riders, and holed at the bottom, or in the most advantageous position, a hole 3 in. diameter might be found sufficient, and give room for the pistons to work in; this would relieve the labour very much as compared with drilling a 5-in. hole, and this seems to be the principal objection to the successful working of the apparatus. The roads in the workings of this seam are regularly watered, otherwise the dust would be troublesome. In the case of explosions of fire-damp opinions are at variance as to the effect of coal dust and powder in the amount of damage they occasion, but there is no doubt the dust raised in a dry mine by these occurrences adds greatly to the heat, and somewhat to the destruction of life. Wrought-iron posts, instead of timber, are used extensively in the engine and other main roads of this pit; the section is in form of a cross, about 3½ in. in width; they are as light as timber, and much more durable.

MODE OF WORKING THE NINE-FEET SEAM.—This is got on the stall and pillar system. The section in the south part of the pit is as follows:—Top coal, 3 ft. 6 in.; black shale, 6 in. to 18 in.; bottom coal, 5 feet: total, 9 feet. When the seam is found as above, the top and bottom coals are worked together—being equal in point of quality—either by single stalls of 6 to 8 yards wide, or by double stalls of 12 to 16 yards wide, pillars of suitable width left between; the waste or gob is stowed, according to material at hand, as the stalls advance. After the full length is driven the roads are filled up with debris obtained from various parts of the mine. When the seam is of greater height than 9 feet, the stalls are driven first in the bottom coal, and stowed up behind, more or less. After the full length has been driven the timber is withdrawn, the top coal then falls, and is only to be filled into the trams. The roads are filled up with debris as the timber is withdrawn, and the top coal got backwards. The breadth of the stalls varies with the strength of the roof; it is generally of medium strength; double timber is used in the roads. The principle of filling up all the excavation is acted upon here, as in the long wall system of the Six-feet seam; this moderates the fall of the roof, and leaves no place for gases to accumulate. This principle cannot be followed out in every seam of coal; there may not be sufficient material for stowing up, but some system should be substituted to secure the same desirable result.

VENTILATION.—Explosions have occurred in former times at these pits, one in 1850, another in 1852; the former was thought to have been caused by taking the top off a lamp; it occurred in the night time, when a number of inexperienced men as colliers were engaged at Lower Duffryn Pits. The present system of working puts it almost out of the power of such men to do mischief; an abundance of air, and the absence of fire-damp in a stagnant state, are the best guarantee for the safety of the mine. The dependence is to be placed, not on the lamps, but on the two provisions named, and with the exercise of ordinary care, and a practical knowledge of ventilation, accidents will be prevented. No doubt advances in this respect are being made in ventilation and coal mining generally, and improvement will be still further promoted by the diffusion of knowledge, and by each member of the mining interest affording assistance according to his ability. The Guibal fans, which are adopted at the Duffryn Collieries, are stated to work uniformly up to 4½ inches of water-gauge, when they begin to slip; this is as much pressure as is likely to be required in the ventilation of mines: the open fans slip at much less pressure; machines of the piston type only can work at pressures much exceeding this. It has been stated that the two fans working together at Lower Duffryn do not give a result corresponding to that obtained by working one fan only; it is probable that a like effect is produced by working two pistons together, as in Nixon or Struvé's machine; and one large piston would be more effective than two small ones having the same area. The blowing-engine on the surface, at the Middle Duffryn, was erected originally to transmit power to coal-cutters. Two of Ridley and Jones's machines were in use in the 2 ft. 9 in. seam, which lies 10 yards above the Four-feet. The coal-cutters were abandoned from the failure of the coal, which was thin and unworkable. It will be observed that the prevalence of backs and riders in the Six-feet and Nine-feet seams render the application of coal-cutters almost out of the question in them, as no holing can be effected to any advantage. The 2 ft. 9 in. and 4 ft. seams are, probably, of the same structural character.

Aug. 31. M. B. GARDNER.

THE SOUTH STAFFORDSHIRE AND SHROPSHIRE COAL FIELDS—No. XIII.

SIR,—Since my last I have seen some remarks by Mr. T. Parton, F.G.S., Prof. W. W. Smyth, and Her Majesty's Inspector of Mines, Mr. Lionel Brough, F.G.S., on the question discussed in these columns. The former contained some friendly criticisms, which appeared in a contemporary; the latter were occasioned by a paper on the subject by me, which Prof. Smyth was kind enough to read before the Geological Section of the British Association, at Exeter, on Monday week. Mr. Smyth said he was himself attracted to the subject from knowing the neighbourhood, and that it was interesting, as dealing with the great national question of the practical extension of our coal fields. It is, undoubtedly, the duty of all who have formed opinions on a matter of so much import to state them, whether they clash with those of others or not; and it appears to me that I shall have done some service if I shall have succeeded in inducing others to depart from the reserve which they have hitherto held. In Broseley, one of the oldest portions of this mining district, practical men have been familiar with the phenomenon known as the Symon Fault for two generations at least; and Mr. Prestwich, who is a Broseley man, and who, from his great love of science, has proved himself such a veteran in the cause, in his paper on the Geology of the Coalbrookdale Coal Field, which was published in the Transactions of the Geological Society, called public attention to it as early as Febuary, 1834. Speaking of the changes the strata undergo within short distances of each other, he says:—

"The curious phenomenon locally called Symon Fault is another instance in point. This apparent fault is occasioned by the gradual, but complete, substitution of the coal by clay, shale, or sandstone. The coal is at first deteriorated by a slight admixture of one of these substances, the proportions of which rapidly increase, until it entirely replaces the coal. This phenomenon is of common occurrence in the neighbourhood of Broseley and Caughley, and occasionally at Madeley and Priorslee. The alteration in the coal varies in extent from 10 to 500 yards." He also says—"A very important example of this phenomenon is exhibited at Malinslee. The upper strata are the first affected, but the altered structure gradually pervades the whole of the measures as they trend eastward."

He then adds—

"The change is apparently produced by an admixture of red and yellow clay, marl, and sand, locally called Calaminker. The upper coals and ironstones are replaced by beds of this character immediately east of Malinslee; the change in the flint coal shortly follows, then they grey and uniformly thick Penneystone stratum assume the appearance of a mottled red shale, and finally the clod and lower coals vanish at Randley Wood, ½ mile east of where the change commences in the upper strata."

As I have previously stated, Mr. Marcus Scott, F.G.S., in his paper on the Symon Fault of the Coalbrookdale Coal Field, read April 24, 1861, also gave important practical details, founded upon observations made by him whilst engaged as check-viewer and surveyor for the owners of the Malinslee and Stirchley royalties, which confirmed the view Mr. Prestwich had taken on the subject; and the same singular phenomenon was commented upon by Mr. Parton, F.G.S., last year. Still, the public appear to know very little about it; and gentlemen, whether owners of property or iron and coal masters, desirous of extending operations on the west from South Staffordshire or on the east from Shropshire, have no clue to guide them beyond what their own experience or judgement might supply, but are left in a perfect sea of doubt.

The gentlemen whose opinions I have adverted to appear to consider the effects as local; whilst I, from observations made probably over a wider surface, feel convinced that they are general, and that they are to be found over a wider area, or, in other words, that the entire coal strata, with such exceptions only as may have been caused by downthrow faults here and there, has been swept away. The report in the Supplement of the *Mining Journal* last week, which contains the only information I have received on the subject of my paper, adds that Mr. Lionel Brough said that in the neighbourhood of Wolverhampton and Cannock Chase there were great dislocations; that he did not agree with the author that a strait had ever existed over the area mentioned; and that, with regard to the continuity of the South Staffordshire coal field in Shropshire, it was interrupted by faults; and he thought that if they sunk deeper in Shropshire they might come on to the Staffordshire coal seams, although, perhaps, under various other appearances.

Mr. Brough appears to assume, and Mr. Parton now states positively, that—"On the other side of Salop there is no dislocating fault along the line of estuary." So far from this being the case, the whole of the coal strata found in the Halesfield Pits of the Madeley Wood Company was saved from denudation by the mere fact of its having been let down by faults below the same strata which suffered from denudation in the neighbouring field of Stirchley. Had the coal strata of the Halesfield Pits retained the same level as that of the Grange it must have been effected by the water of the estuary; but having been let down more than 300 ft. below it, it escaped the cutting action of the waves. Again, the coal strata at the New Kemberton Pits was let down 100 ft. or more below that of Halesfield; had it not been so, the fact that it is 900 yards further along the old coast line in the direction of the estuary would have proved its destruction; but it escaped, from the same cause as the coals of the Halesfield Pits escaped; whilst the coal measures of Hills Lane, again, which stood higher than those of either the Kemberton or Halesfield Pits, although further removed from the east, suffered largely, not only the Top coal but the Big Flint coal, 100 feet below it, having been completely destroyed, thus affording an interesting and convincing illustration of the theory of denudation. So far from there being no dislocation or disturbance, too, along the line of this old estuary, there are innumerable instances of fractures, compressions, depressions, latteral pressure, slips, fissures, of the turning upwards and downwards of the edges of the measures, dislocations, and changes of level, at Malinlee, Halesfield, Kemberton, Hills Lane, and Shawfield. At the latter pit the late Mr. J. Anstice, in honour of whom a very handsome memorial building is just now being completed, a short time before his death had a heading cleared into the Symon Fault for me to see, and I was surprised at witnessing the evidences of disturbance on approaching the denuded edges of the seams, the coals in some instances being quite vertical in the roof of the mine. Again, at Blisser's Hill Pits, still in a south-westerly direction, near the Hay, and along the same line of denudation, the measures rise at great angles in the direction of a fault, the effects of which are to be seen on the surface. Mr. Anstice showed me specimens of hard,

red, ironstone-looking rock, which the men found in heading into this fault 40 years ago. It is, therefore, clear that along the eastern side of the Shropshire coal field, where we have undoubted evidences of denudation, we have also equal evidences of disturbances combined. On the opposite, Staffordshire boundary, evidences of disturbances are so frequent that they obscure those of denudation. Yet here the red rocks overlap the coal measures, as on the Shropshire side, and the thick coal is found beneath it. Faults are described as leaning at low angles, and the red rocks as considerably overhanging the coal measures, which dip sometimes gently at first, and then rapidly to the west. East of the mouth of the railway tunnel at Wednesfield Heath the red rock was found dipping westwardly, and the coals also, being much broken; the flat ironstone, about 160 yards below the New Mine, coal was found to continue 100 yards beyond the latter, which would give an inclination of 5 in 8. At other places, as at Old Swinford, the slope against the brick-red sandstone is 45°. The pale-red and whitish sandstones with calcareous bands, similar to those on the Shropshire side, which may be seen in the cuttings of railways about Wolverhampton, follow the same inclination and dip at easy angles; and at the new water works the dip of the still higher rocks, and the marls of more decided Permian character, maintain the same inclination. It is very difficult to say to what these fractures and inclinations in all cases are due, but I think sufficient evidence may be found to show that they do not belong to any one cause acting at one particular time, but to various causes operating at several different times. Some of these displacements were due to elevations, some to subsidences, and others, again, to denuding agencies, which, undermining the newly-formed coal measures, brought them down from their original levels in step-like stages towards the trough of the valley. It may be in some cases that subsidences, similar to those which we have alluded to as having saved the Halesfield and Kemberton coal tracts from the destruction which befel more exposed ones, may have also preserved for us others on the South Staffordshire as on the Shropshire side; but, looking along the mouth, or southern entrance, to this valley of denudation, and at the trial sinkings and borings already made, we feel persuaded that the mid-portion of this great store-house has been rifled of its contents, and that the red rocks will in most cases be found to rest upon its flooring, or foundation—Silurian rocks.

Madeley, Salop, Sept. 1. J. RANDALL, F.G.S.

COLLIERY WORKING, AND VENTILATION—No. II.

SIR,—In my letter on this subject, in last week's Journal, there is an error. It is said that before the invention of the Davy lamp, &c., the number of *explosions* had reached the maximum, &c.: the word *explosions* ought to be *openings* or *shafts*.

I am afraid it will be uphill work to attempt the advocacy of an increased number of shafts, yet it appears to be imperative; at any rate, it is clear that a greater amount of workings are accumulated or extended from some shafts, and those workings cannot all be kept clear of gas—hence the result, those dreadful explosions. It is in vain to expect aid from new inventions and improvements for ever. It is quite clear that if moderate establishments had been adhered to the improvements that have been effected in ventilation must have placed the works in a state of comparative safety. No doubt competition has something to do with this, and the cry constantly is—"more coals," "a larger quanity, in order to reduce the cost of production." But it is considered by many that imprudent emulation has much more to do with it. No matter what is effected, every new opening is expected to excel all former concerns; and it may be well to enquire whether this is likely to lead to profit—at any rate, much risk is incurred; indeed, when the coal to be worked is not of a fiery character the works may be carried out to an almost indefinite extent, and yet little risk of explosion be incurred; but when the seam is of a fiery character the case is very different, and the greatest care and caution is necessary in prosecuting the works, and it may safely be asserted that in the long run a moderate establishment in connection with two shafts will prove most profitable. It is clear that the profits of years may be swallowed up by the damage caused by one explosion, and this happens but too often. It is in vain to expect that the most complete arrangements, the most powerful machinery, or the most perfect ventilation even, will prevent these explosions. Of course, I allude to *general* arrangements and *total quantities*. A coal mine is not a simple machine after you quit the downcast and upcast shaft, but one of a most complex character, and a powerful ventilator may, in some cases, only increase the force of the explosion, and no doubt this has occurred in many instances.

It may appear invidious, but I would venture to suggest that the number and kind of men composing the staff engaged in the management of collieries in various districts would throw some light on the matter of explosions; of course, I allude to the men employed underground in the various districts and departments of a mine. I must confess that I never could hear the term "fireman" used, which is so common in the South and in Wales, without a shudder. I would recommend that office to be abolised altogether; of course, there must be *overmen*, &c. If any of your correspondents could give a list of the officials in the various districts, and some idea of their duties and position, I beg to submit that their lists might be useful. I give a slight idea of the staff generally employed in the North:—

Overman.—Charge of all the works and main roads.

Back overman.—Under the orders of the viewer.

Deputies.—Charge of the districts under the overmen.

Master shifter.—Charge of all the men employed at night on the roads, &c.

Master wasteman.—Charge of the airways, and the men in them. This is only a rough idea.—*Newcastle, Sept.* 1. M. E.

MINING BY MACHINERY.

SIR,—As I am aware that the readers of the Journal take a great interest in the progress of every class of mine machinery, I may state my opinion of Mr. F. B. Dœring's rock-driller, which undoubtedly will surpass every other machine of its class—possessing all the advantages than can be desired. The principal feature is its light weight, and, at the same time, combination of strength in its construction. I have seen it at work on the hardest white granite, and the result has been at the rate of about 2 in. per minute. The average time of an experienced miner in drilling a hole of 18 in. in the same rock would be about three hours, and the above-mentioned driller would do the work in ten to fifteen minutes, calculating for stoppages.

As consulting engineer to the Symdde Dylluan Copper Mine, near Carnarvon, and with the sanction of the owner of that mine, I have made arrangements with Mr. F. B. Dœring to supply us with one of his rock-drillers, and Messrs. de Winton and Co., the well-known mechanical engineers of Carnarvon, have undertaken to attach to one of the water-wheels at the mine the machinery necessary for working the drills. In due time I will inform you of the results. At present the work will be concentrated to the principal shaft in the mine, at a depth of about 65 fms. HENRY SEWELL.

MANUFACTURE OF IRON AND STEEL.

SIR,—Several important improvements have recently been introduced in connection with the manufacture of iron and steel by Messrs. Jeavons and Waplington, of the Atlas Steel and Iron Works. The processes are not patented, and, therefore, the description will be the more interesting to the readers of the Journal. In order to decarburise the iron while in a molten state in the puddling-furnace a vessel of suitable size, attached to the end of a bar or rabble, is filled with nitrate of soda and oxide of iron, or other suitable substance containing and capable of evolving oxygen. The vessel is then moved about under the surface of the molten metal, the result being that oxygen is evolved from the material contained in such vessel, and the same combines with the carbon in the molten metal, and, according to the extent of the operation, produces such quality as may be desired. In order to protect the tray of iron, which is lined with fettling in the ordinary manner, from injury by the intense heat raised in the puddling-furnace, it is preferred to pass a current of air around and under the tray to the fire-grate.

The ash-hole of the grate being closed, the air is heated in its passage around and under the tray, and effects economy in the consumption of fuel and in the durability of the furnace. In order to ensure uniformity in the quality of the iron or steel produced, instead of the usual machines for working the rabble a simple arrangement of steam-engine above the furnace is employed, the same being connected direct to the hanging-bar which carries the rabble, and being furnished with suitable valve-gear and horizontal revolving motion (as well understood), so that the motion of the rabble in the puddling-furnace may be controlled, and the same worked in any part for such length of time and stroke as the manipulator or puddler may determine.—*Sheffield, Aug.* 25. K. H. C.

ON THE PRESENCE OF DIAMOND IN THE METALLIFEROUS SANDS OF FREEMANTLE, WEST AUSTRALIA.

SIR,—On Tuesday week last, having wandered into Section C of the British Association, at Exeter, when Prof. Tennant was speaking of diamonds recently brought from the Cape of Good Hope, I was reminded that in the year 1862 I accidentally discovered diamonds in some metalliferous sands from Freemantle, West Australia, and that, in January, 1867, I communicated the fact to the Academy of Sciences at Paris ("Comptes Rendus," vol. lxiv., p. 87). I had forgotten all about it; nevertheless, it may be interesting to place the fact on record in your Journal, which circulates so widely among practical men, and, with your permission, I will briefly sketch the circumstances under which the observation in question was made.

At the time of the International Exhibition of 1862, I was requested to make analyses of several Australian minerals and metallic ores, which formed one of the most interesting sections of that memorable Exhibition. Among the specimens forwarded to my laboratory were two bottles of metalliferous sand from Freemantle, chiefly composed of the mineral *iserine*, and yielding to analysis 10 to 18 per cent. of titanic acid, 5 to 8 per cent. of silica, and about 81 per cent. of protoxide and peroxide of iron, containing a little zircinia and oxide of manganese. Assayed by the dry method, about 59 per cent. of iron was produced from this sand. Sometime afterwards I submitted the sand to a careful microscopic examination, and the results were rather interesting. To the naked eye it appeared simply as a brilliant black sand of metallic aspect, in which a number of white specks could be distinguished; but under the microscope, by means of a low magnifying power, no less than six distinct species of minerals were recognised in it without much difficulty. The following is an enumeration of them, beginning with the most plentiful:—

1.—*Iserine* (titaniferous oxide of iron), in crystalline grains, more or less octahedral, black, of metallic brilliancy, and various sizes.

2.—*Silicate of zirconia*, in white opaque crystals, of very great neatness, square prisms terminated by the quadruple facettes as usual, very similar in size, the edges and angles being only slightly used by friction.

3.—*Hyaline quartz* and *milky quartz*, in irregular grains, easily recognised by their vitreous aspect and their peculiar fracture, in grains sometimes as large as those of the iserine.

4.—Minute crystals of pink topaz, with some yellow and white topaz, exceedingly brilliant.

5.—Crystalline fragments of *apatite*, of a greenish colour, and nearly transparent. The form of these fragments allowed them to be readily distinguished from fluorine, and they had neither the brilliant green of the emerald, nor the pale colour of beryl.

6.—Here and there a small diamond, which was at once recognised by its characteristic crystallisation. Some showed themselves as crystals of 144 facettes and more, nearly spherical; under the microscope these facettes appear black by reflection, and transparent by transmission. They are distinguished without difficulty from the grains of white topaz, first by their crystalline form, by the great number of facettes, which give them a rounded form, and next because they appear much less brilliant than the grains of topaz. I calculate roughly that there is about one diamond in 1500 grains of the sand; the crystals are completely isolated, and perfectly defined.

The Cedars, Putney, Sept. 1. T. L. PHIPSON, Ph.D., F.C.S.

THE MINERAL WEALTH OF PORTUGAL.

SIR,—I read, with considerable interest, a paragraph bearing this heading, published in your last impression. During a residence in Portugal of nearly three years I visited every mining district in this comparatively unexplored country, and can only add my testimony of its extraordinary richness in minerals. In the beginning of 1865 I visited the coal workings of the Portugal Iron and Coal Company, at Leiria and Marazes, and found almost inexhaustible quantities on the seashore near to Marinha Grande. A black seam, some 7 or 10 ft. in thickness, appearing in the cliffs, and extending at least five miles. You were good enough to report the results of my experiments in your Journal of April 1, 1865. I experimented with this coal, which was of the lignite character, but the Portugal Iron and Coal Company preferred wasting their money on their iron mines, with the disastrous result of "liquidation;" whereas, had the managing director (the late Mr. John Diston Powles) been a little more liberal in the way I pointed out to him at the time, I am sanguine enough to believe that the company might even now have been in existence, possibly paying a handsome dividend to the now unfortunate shareholders. The pyrites mines at Estremoz and Bogalho, of Senor J. R. Tocha, are not noticed in your paragraph, nor those of the late Oporto Mining Company, at Serradella, near Penafiel; these are of silver-lead (galena argentifera), and are in my opinion most valuable properties. Still further north are mines at Chane, in the Conselho de Villa Nova de Fozcoa, which are now being worked by Mr. Russell, the original concessionaire. Again, coal and slate are found on the River Sousa, which is most admirably situated for water carriage to Oporto, and the large and extensive slate quarries of the Vallongo Slate and Slab Quarries Company, at Vallongo, seemed to have escaped attention. While speaking of Vallongo, I cannot forbear mentioning the interesting workings for gold in this district. One hill side is riddled, as it were, with the traces of the Roman workings; down one of these I found gold quartz of fair value. Antimony mines are also here, and have been largely worked by the Companhia Perseveranza. The silver-lead mines at Bracal, and those of the Lusitanian Mining Company, at Palhal, also merit a passing notice, the former being carried on by an enterprising German, a large village has grown up, and has risen with the extension of the works, which comprise smelting and reducing works; these, at the time of my visit, were being vigorously worked, and apparently it would be a long time before they could be worked out. Mr. George Croft, of Lisbon, established reducing-works near his copper mines at Borba, which has amply repaid the capital expended on them; the metal is reduced by the electric process. The extensive mines of tin and lead of Messrs. Chamico, in the Teaz os Montes, must likewise be remembered. The large quantity of marble and hard stone in the district north of the Douro is also something marvellous; the native stonemasons, although slow, are very skilful indeed, and in the building of the Place do Commercio, in Oporto, can be seen fine specimens of this industry. I have also seen petroleum springs in the district of Leiria, and also near Busaco—tin in the Alto Douro—and, in fact, my travels in that country only served to show what boundless fields of work there are. Were the Portuguese sufficiently educated up to our standard, they would certainly not allow the internal wealth of the country to be practically in the hands of foreign capitalists. Their Government offers every inducement to stimulate mining enterprise, but results are unfortunately against native speculation. I can endorse everything you say of the San Domingos Mine, and a tribute of praise should be accorded to its spirited and enterprising proprietor, Mr. James Mason (now the Barao de Pomaron), who has converted one of the "desert places of the earth" into an oasis, by the building of the town of Pomaron, on the most approved scientific principles, having a beneficial regard to the well-being of his workpeople. From my intimate knowledge of almost every mine in Portugal, I feel much interested in reading any accounts of the progress of mining enterprise, and I should much like to see the superfluous capital of this country turned into a channel so near home, without being sent to support the "burrowing of the moles" in the far off Andes, or the Cordilleras. The one, in my opinion, is far more legitimate than the other. As I before observed, the Portuguese Government is most courteous to mining adventurers. All the machinery and implements for working mines enter the country duty free, and in granting concessions they are most liberal. The great interest I feel in the subject must be my apology for troubling you with this letter; and I will, with your permission, on a future occasion give you some of the actual results of the working of these mines, to which attention should be drawn, as I feel sure they will most favourably compare with other mines in more favoured and more distant countries.—*London, Aug.* 27. CHAS. B. KING, C.E.

FACTS OF THE SAND FORMATION OF THE SOUTH OF THE ISLE OF WIGHT BASIN.

SIR,—At about a mile to the north-west of the village of Fawley, which is seven miles to the south of Southampton, are two sand pits, near Mopley Pond, and on the two opposite sides of a valley of about 200 yards wide. Of one the sand is so fine as to feel like flour, the grains to be seen requiring a good magnifier, whilst those of the other are perceptible to the naked eye. The former is used for mouldings, and the latter for brick-making; and while removing the surface of the coarse sand I disintered not only a few small pebbles, but also *bits* of chalk, with small pebbles attached to them.

These sand hills, we know, were *deposited*, or, as the geologists have it, were washed into a chalk basin, and during my investigation I have observed in them what may be termed a base line, or deposition, apparently separating the formation of one period from that of another. In the fine sand pit this layer consists of clay, about 9 inches thick. The layers of sand under this line are apparently level, whilst those above accumulate gradually from the base to the top of the sand hill; and whilst the same system prevails in the coarse sand pit, the horizontal or separating layer, instead of being clay, is sand, combined with an oxide of iron; so that these mounds or hills, instead of having been formed by an elevating force, are actually in the position of their deposition.

Both the fine and coarse sand hills are covered with gravel, and as the valleys existed at the time of its deposition it may reasonably be assumed that all these valleys were filled with it to the summit of the hills at least, and, as a necessary consequence, when the belt broke up, and vent was given to the waters of the basin, the gravel of the valleys, and most of that on the hills, was carried into the chasm now forming the channel, so that there is no difficulty in defining where the beach and sand on the sea shore came from.

Here, then, is evidence that within the same basin, and within 200 yards of each other, there were accumulated two mounds of sand of totally distinct characters; and the *layers* of the coarse sand are both more brilliant and varied in colour than are those of the fine sand, whilst the layers of the sand of the cliffs at Eaglehurst, at about a mile to the south-east of the sand pits, is more brilliantly variegated than even that of the coarse sand, although apparently finer, all which facts tend to prove that, at least at this period of the formation of the belt, there was in operation a principle which, as I have before said, may be expressed by natural selection, and to the operation of which principle the matter must have had free circulation, and have been destitute, or nearly so, of what is understood by weight.

This reasoning, of course, applies equally to the valleys of the Thames, Medway, Seine, &c., and other *winding* rivers, all of which, at the time of the "break-up," must have been full of matter, that was carried into the Channel; and I suspect strongly that as the locality of the Straits of Dover and Calais was just about midway, the shallowness of the Channel there is due to the accumulation of matter, and not to the matter not having been washed away; and if so, a tunnel through such matter for a railway is clearly out of the question.

The cliffs at Eaglehurst afford evidence not only of the sand having been accumulated as mounds, but also, in some cases, of the sides of those mounds having been perpendicular several feet from the base, forming hollows, into which the gravel flowed when it overran the sand hills, and which gravel could have come from no other source than the ocean to the north.

These layers of differently coloured sands, when viewed from a distance, appear to be some 2 or 6 inches thick, but on the careful removal of the surface with a knife, so many as 10 or 12 layers may be counted to the inch; and what may appear startling, the layers are not only horizontal, but also vertical, or at right angles to the horizontal layers, which latter fact is conclusive evidence that those layers were not worked in.

At Eaglehurst, where the gravel appears to have flowed into shallows, all the larger stones are in the lowest *layer*, and in many cases, where the cliff has been washed down by the sea, there are on the beach solid masses of concrete of, in some cases, blocks of about 3 ft. in diameter, composed of small pebbles and coarse sand, whilst many of the *layers* at the bottom yield to the most insignificant force, some of them being nothing more than an accumulation of loose rounded stones. Was, then, the course of the rivers clearly defined before the raising of the higher lands from which they are supplied?

The greater part of the larger flints have not only the impression of smaller ones on their surface, but also frequently enclose them. The bottom of the freshwater ocean to the north must have been comparatively hard, and have possessed a hardening property; it is not, therefore, improbable that the first-deposited large flints became comparatively hardened, and by their gradual progress to the belt some would be broken into fragments in their lines of cleavage. When the ocean intruded, by the sinking of a portion of the belt, the top water would be the first to overrun the belt, carrying with it the flints in suspension, some of which would break up, whilst others would retain their larger dimensions, and as a necessary consequence, as the latter indurated, they would have the impression of the matter with which they came into contact; and it is possible that this portion only constitutes the mass of the gravel on the sand formation, whilst that of the bottom of the ocean may have come in at a much later period, the boulder carrying with it in its progress all the matter (the boulders, clunch, clay, &c.), these still in a soft state.

I have never seen a boulder formation, and none of the works at my disposal state what its gravel consists of, but as at this period there was neither hill, dale, nor comparatively weight, a *few* of the difficulties enumerated in the following will no longer prevail:—

"A short distance from the tower of Nant-y-Balan may be seen a huge mass of tumbled red clay overlying the coal measures. It is the bed or the bottom of the new red sandstone formation. For a thickness of 100 yards it is *full of the debris of the older formation*, from the primary granite to the white freestone, which interstratifies the coal in the parish of Ruabon. Here and there we find relics of the carboniferous series, and, thinly scattered, a few vegetable and marine fossils, amidst a mass of clunch and clay, and shale and gravel; but what strikes us with the greatest astonishment is the huge boulders which lie buried in its mass, and surround us on every side. Whence come they, and by what agency? Here are granite and slate, basalt and limestone, chert and grit. Some of these boulders, too, are of immense size, measuring many yards in length, breadth, and thickness; that which lies a short distance from us, and half embedded, is of such vast bulk as to be, probably, some hundred tons in weight. It is basalt; but how came it here? Call to your aid the active forces of the elements—*fire, air, and water*—and calculate the power that would be required *to lift and transport* this enormous body *from the rock* in which it was once incorporated to the spot where it now lies, a distance of, probably, 80 or 100 miles, over hills and mountains of almost inaccessible approach, and through gorges and ravines of inconceivable difficulty. You are puzzled, amazed; equally so would Euclid and Archimedes have been; nevertheless there the huge phenomenon lies, and in a stratum, too, to which it is alien; its form is *flat* and much worn, as from *slow* and laborious travelling."

This huge flat stone clearly *floated* to its present resting place.

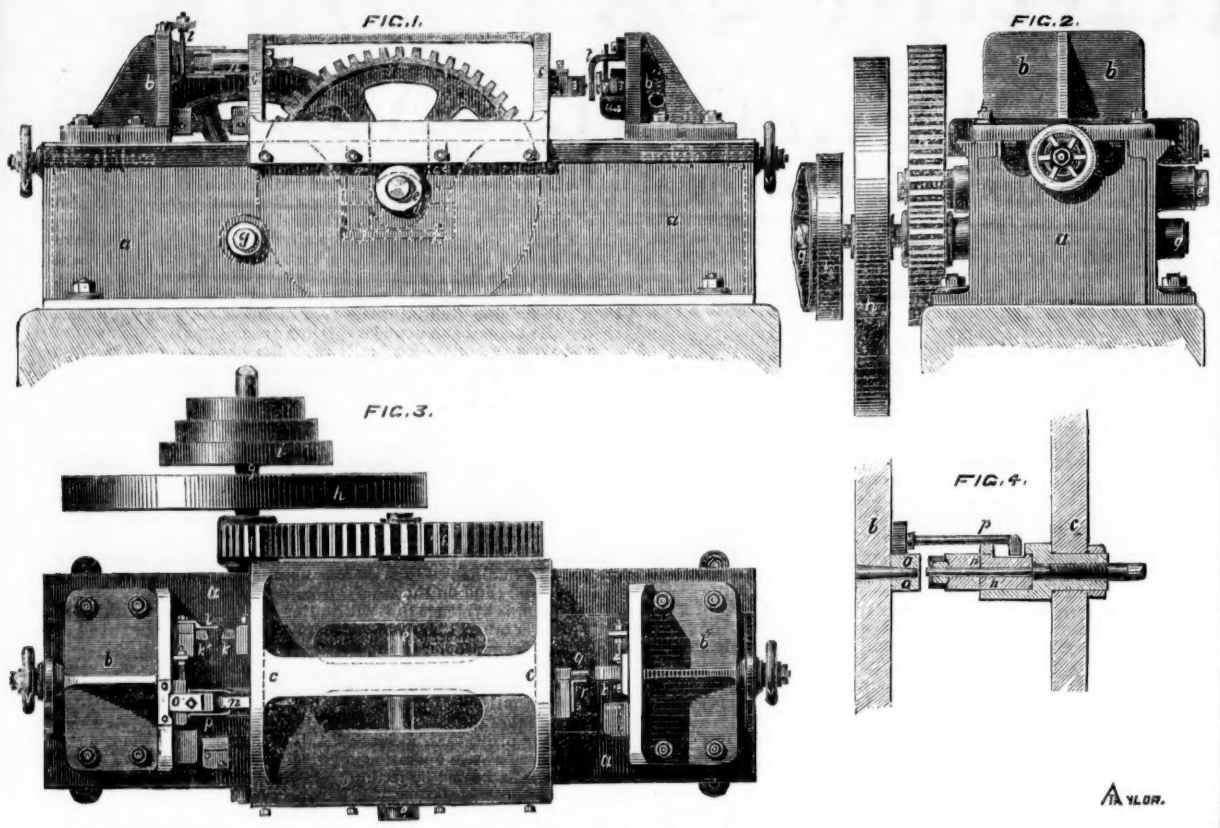
Bay Cottage, Fawley, Aug. 27. FRANKLIN COXWORTHY.

[For remainder of Original Correspondence, see this day's Journal.]

IMPROVEMENTS IN COPPER SMELTING.—In the process of manufacturing copper Mr. H. H. MURDOCH, of Staple's Inn, proposes to use a blast-furnace of an improved form, similar to an ordinary ironfounder's cupola furnace, with the exception that a high pressure blast is used and distributed in a zone or belt around the furnace just above the cupola part by means of numerous air passages or tuyeres made through the lining or side of the furnace at an angle to the horizon, instead of a low pressure blast being introduced through a hole, as in the ordinary cupola furnace. The tuyeres are supplied with air by means of an air channel running round the exterior of the furnace and communicating with the said tuyere holes, into which channel air of the required pressure is forced. In smelting or reducing copper regulus according to this invention the regulus is charged into the above described furnace, and the melted regulus is allowed to rise above the tuyeres, and is subjected to the action of the air, which is forced through the said tuyeres into and through the said regulus.

BLOWING, EXHAUSTING, AND VENTILATING.—The invention of Mr. E. J. NONALHIER, consists of a tube which is surrounded or surmounted by another tube extending round the whole or a portion of the length of the first tube, and provided with a number of vanes, deflectors, or curved or other plates which together with radial or other partitions or plates, form air ducts or passages into and through which air is drawn, and whence it passes away round the top or end of the inner tube. The parts may be fixed so that the apparatus may be conveniently used in all requisite aspects, positions, or places. To prevent counter currents, a spherical or otherwise shaped cowl or a dome-shaped cap may be pivoted or hung at the top or the outer tube, so as to take the required positions or inclinations for this purpose.

IMPROVED MACHINERY FOR GETTING COAL.



The invention illustrated in the accompanying engraving relates to a method of getting coal, ironstone, or other similar mineral by the process called undermining, or holing, wherein a recess or channel is cut or grooved out near the bottom or floor. When the support is thus removed the upper part of the coal or mineral is detached and brought down by inserting wedges above. The invention, which has been patented by Mr. J. S. WALKER, of Wigan, consists principally in the employment of a peculiar form of disc cutter, mounted horizontally on a short vertical shaft, and driven by bevel gearing actuated by a compressed air-engine, the whole being mounted on a carriage supported on wheels running on a tramway, and propelled slowly along the face of the coal or mineral by means of worms and worm-wheels, also actuated by the same or an auxiliary compressed air-engine. In the annexed engraving (for which, with the description of the machinery, we are indebted to the *Mechanics' Magazine*) is a longitudinal section, and Fig. 2 a plan view of this apparatus.

The framework *a a* of the machine is of wrought-iron, carried by flanged wheels *b b* on the tramway *c c*. This framing supports the cylinder *d d* (see also face view, Fig. 3), crank shaft *e e*, and other parts of a compressed-air engine of the ordinary construction. The crank shaft *e e* turns in bearings, and has keyed near one end the toothed pinion *f f*, the teeth of which are slightly tapered to enable it to gear with the open radial teeth *g g* formed between the inner and outer rims of the cutter-wheel *h h**, the boss of which turns on a vertical studd *i i* carried by the frame *a a*. The outer rim of the cutter-wheel *h h* is provided on its periphery with snugs or projections, between which the cutters *k k* are fixed by means of keys. In front of each cutter is bolted a piece of metal * *, which acts as the brake-iron of a carpenter's plane, and prevents the cutters from attacking the coal too deeply at once. This piece is lined with wood, which can be easily pared away as the cutters become worn. The cutters are mounted in groups of four or five, following each other, so formed and arranged that each successive cutter attacks a different part of the groove or channel cut by the wheel, and the whole group leaves no part uncut, the face of the widest cutters being wider than the rim of the wheel, so as to be able to allow of sufficient clearance, and the spur teeth *g g* are open or slotted completely through the wheel *h h**, so as to allow the cutting to falls through the openings, and thus prevent the choking of the cutting wheel. The wheel *h h** is made in two parts, bolted together when in use by means of plates *l l* (see fig. 3, and also the detached sections, figs. 4 and 5). The boss of the part *h* turns on the stud *i i*, whilst the boss of the upper part *h** is of a larger diameter, and fits outside on the former, so that, upon unbolting and removing the plates *l l*, and lowering the stud *i i*, by unscrewing the bolt *m m*, as seen at fig. 4, the half *h** of the wheel can be turned half-way round and brought over the half *h*, so that the whole of the wheel lies beneath the frame, and the width of the machine is reduced by nearly one-half. The object of this arrangement is to facilitate the transport of the machine from place to place, and to enable it to pass through parts of the mine where it would be impossible to introduce it with the cutter-wheel in its entire state. *n n* are four screws, by means of which a certain amount of inclination may be given to the machine if desired, or whereby the machine may be levelled if preferred, notwithstanding any inequality in the level of the rail or tramway. *o o*, fig. 1, is a sheet-iron cover, which may be applied to the machine.

The machine may be caused to progress by driving one of the axles slowly by means of a worm and wheel, actuated either by the same compressed-air engine, or by a small auxiliary air-engine carried in the vacant space of the frame *a a*, in front of the rear axle. Mr. Walker, however, prefers to fix a rope to the front part of the machine, and draw it forwards by means of a winch or crab placed in advance. When the machine is upon a slight incline it will advance without any external aid. By a slight modification this machine can readily be adapted to hole or cut the coal or other mineral at the sides, or near the top of the seam, if required.

We are informed that this machine is daily at work, with very satisfactory results. In coal without "bone" it will hole at the rate of from 30 yards per hour and upwards with 20 lbs. pressure, and requiring the attendance of one man only. We hope shortly to place before our readers some authenticated results of continuous working of this useful apparatus.

REFINING IRON, AND MAKING STEEL.—The invention of Mr. H. A. BONNEVILLE, Sackville-street, consists first, in introducing fuel or fluxes, either in a gaseous, liquid, or solid form, into the molten metal in a converter, by suction (in contradistinction to the process heretofore known where fuel has been introduced by force) in such a manner that the quantity of fuel, as well as the quantity of air introduced into the molten metal, can be regulated, and the requisite amount of heat for refining the iron, or for converting it into steel, can be produced. Second, in subjecting the fused metal in the converter to a forced current of air in combination with the current produced by suction, or by a vacuum apparatus, in such a manner that the advantages of the vacuum process are combined with those of the forced air process, and that the action of the air on the fused metal can be regulated with greater facility and nicety than it can if either the vacuum process or the forced air process is used independent of the other.

SEPARATING ORES, &c.—The apparatus invented by Mr. G. DAVIES, of Manchester, now comprises a long horizontal hutch or cistern, constructed of wood, bound with iron straps, and formed with a semi-cylindrical bottom. This hutch is divided into four jigging compartments by transverse ends and partitions, and there is also a similarly separated end compartment to receive what passes over the last jigging compartment. A vertical partition extends along the upper parts of the compartment, and on one side thereof there are a set of plungers or pistons to produce the jigging motion of the water, whilst a series of sieves are placed on the other side. On the tons of the partitions, there are fixed a number of standards to carry a longitudinal revolving shaft, provided with fast and loose pulleys for a driving belt, and with eccentrics, which, by means of connecting rods, actuate the plungers. The eccentrics are adjustable on their shaft, so that the stroke of each plunger may be adjusted separately to suit the materials it acts upon.

FOREIGN MINING AND METALLURGY.

The exports of coal from Belgium in the first five months of this year amounted to 1,397,061 tons, against 1,402,629 tons in the corresponding period of 1868, and 1,332,340 tons in the corresponding period of 1867. These totals were made up as follows:—

Direction of export.	1869.	1868.	1867.
Russia.....Tons	650	—	—
Zollverein	6,278	4,243	3,088
Low Countries	44,713	41,516	35,333
France	1,345,219	1,354,721	1,291,694
Turkey	101	—	—
Other destinations	100	2,149	2,225
Total	1,397,061	1,402,629	1,332,340

The slight falling off which is observable in this year's figures occurred entirely in May, as during that month the exports only amounted to 271,589 tons, against 337,574 tons in May, 1868, and 300,140 tons in May, 1867. The falling off occurred in the exports to France; on the other hand, the deliveries to Holland and the Zollverein made some progress. The exports of coke from Belgium show an almost constant progress. Thus, while they were 227,000 tons in the first five months of 1867, and 215,234 tons in the first five months of 1868, they increased in the first five months of 1869 to 256,843 tons, showing every month an advance upon the corresponding month of last year—a state of things which, as has been already stated, has not altogether obtained with regard to coal. The re-opening of the navigations has occasioned a slight revival in the Belgian coal trade, which has not, however, been wholly maintained. The demand for coal for industrial purposes maintains a certain activity, otherwise the Belgian coal trade might be said to be in the midst of its dead season.

Tables illustrating the commerce of Belgium show that the imports of minerals into that country amounted in the first five months of this year to 195,783 tons, against 133,560 tons in the corresponding period of 1868, and 103,297 tons in the corresponding period of 1867. The considerable increase observable in this year's figures is explained by the condition of the Belgian works, which have been displaying great activity since the commencement of the year; it further confirms the exhaustion in the mineral bearings of Belgium, to which attention has been more than once called under this head. It is only of late years that the imports of minerals into Belgium have acquired any real importance; in 1862 they only amounted to 43,250 tons. It may, then, almost be said that the essential conditions of Belgian metallurgical production have experienced a complete change during the last seven years. The exports of pig from Belgium present a sensible increase this year, having amounted to 8161 tons to May 31, as compared with 5636 tons in the corresponding period of 1868, and 4179 tons in the corresponding period of 1867. The imports of pig into Belgium in the first five months of this year showed little variation as compared with 1868, the total to May 31 this year having been 16,542 tons, against 15,881 tons in the corresponding period of 1868; these totals are sensibly below the figures for the first five months of 1867, which stood at 22,159 tons. England continues to send Belgium the largest proportion of the pig imported into that country; thus in the first five months of this year 14,406 tons of English pig entered Belgium. English pig would seem to have obtained a certain footing in Belgium; thus while in the first five months of this year 14,406 tons were imported, the receipts for the whole of 1860 were only 749 tons. The exports of rails from Belgium continue to make progress, having attained the following importance during the first five months of the last three years:—

Direction of export.	1869.	1868.	1867.
Russia .....Tons	13,227	23,165	40,165
Hanse Towns	—	106	147
Denmark	475	—	—
Zollverein	1,579	2	11
Low Countries	1,137	1,057	944
England	—	3	25
France	450	234	151
Spain	21	15	33
Italy	9,373	2,850	2,450
Turkey	10,603	—	—
United States	3,030	—	—
Rio de la Plata	220	—	—
Other destinations	1,780	165	4
Total	41,895	24,597	13,930

The exports of rolled iron from Belgium also present some progress, having been 34,240 tons in the first five months of this year, against 28,611 tons in the corresponding period of 1868, and 23,258 tons in the corresponding period of 1867. Plates exhibit no less satisfactory results, having been exported to the extent of 8731 tons in the first five months of this year, as compared with 5586 tons in the corresponding period of 1868, and 5524 tons in the corresponding period of 1867. The whole of the exports of pig, iron rails, plates, castings, &c., amounted in the first five months of this year to 100,114 tons, as compared with 75,094 tons in the first five months of 1868, and 84,473 tons in the first five months of 1867. The state of the Belgian iron trade has not materially changed of late. Prices have been maintained with much firmness, especially as regards plates, in which an advance is anticipated. Orders for merchants' iron continue to arrive at the works; mention is made, for instance, of an order for 6000 tons for a bridge, to be constructed at Hamburg, and another order of 1500 tons for Lisbon. The Charlerol Committee of Forgemasters continues to address well nigh interminable transport reclamations to the Belgian Minister of Public Works.

The annexed table shows the imports of pig and castings into France in the first six months of this year, as compared with the corresponding period of 1868:—

	1869.	1868.
Imported duty free .....Tons	68,969	46,721
,, for shipbuilding	909	704
,, with payment of duties	4,989	10,069
Total	74,857	57,494

As regards iron and plates, the totals stand thus:—

	1869.	1868.
Imported duty free .....Tons	23,837	23,875
,, for shipbuilding	4,122	4,507
,, with payment of duties	4,970	5,194
Total	32,929	33,576

The total imports of foreign minerals into France in the first six months of this year were 278,786 tons. This total was made up as follows: Belgium, 60,729 tons; German Association, 39,956 tons; Spain, 39,917 tons; Italy, 28,451 tons; Switzerland, 216 tons; Algeria, 108,228 tons; other countries, 1289 tons. In the Haute-Marne the state of affairs has not materially changed of late; drought has, however, compelled some establishments working with hydraulic motors to suspend operations, and the execution of orders may be somewhat delayed in consequence. There has not been much doing in rough pig; a small lot of half coke-made pig has changed hands at 3*l*. 8s. per ton. The foundries are well employed, and do not anticipate any slackening in the demand, as the period of the year has now arrived at which orders are given out for winter articles. The works of the Ariége display a tolerable amount of activity, and Pamiers is about to make an advance of 8s. per ton.

A company, having M. Goubonine, a railway contractor, at its head, has leased a rich bearing of coal in the district of Dankow, in the Government of Riazan. It is understood that the promoters of the company intend to establish in the locality works for the production of rails. M. Barbot de Marny has been charged with the task of exploring the new coal-bearing, which is said to be of immense extent.

The Cheratte, Housse, and Bouhonille Collieries Company has just been organised; it has been formed for the working of the Cheratte, Housse, and Bouhonille Collieries, the sale of their products, and, if deemed advisable, the production of coke, briquettes, &c. The company is authorised to issue obligations to an amount not exceeding 12,000*l*. The statutes provide beforehand, in the usual French and Belgian fashion, for the allocation of the profits; 7½ per cent. is to be devoted to the administration, 1½ per cent. to the commissaries, 6 per cent. to the employees, 15 per cent. to the reserve fund, and 70 per cent. to the shareholders. The production of the Werschen Weissenfels Lignite Company for 1868-9 amounted to 1,572,103 tons, of which 1,307,858 tons have been sold. The profits of the past exercise amounted to 77,595 thalers; of this sum 7659 thalers will be paid to the reserve fund, an equal sum will be allowed to the Council of Administration, and the balance, or 63,911 thalers, will be devoted to the payment of a dividend to the shareholders, at the rate of 11 per cent. per annum. The Marienberg Argentiferous Mines Company provides no dividend for its shareholders for the past year. The company is, however, enabled to pay out of the profits realised for the past year the ordinary statutory interest, which is not to be despised. The report of the Aix-la-Chapelle Chamber of Commerce for 1868 gives some details on the results obtained by mining and siderurgical industry in that district. The Aix-la-Chapelle and Hoegen Mining Company produced last year 3,692,392 bushels of coal, and 119,565 quintals of coke. The Stolberg and Westphalian Company for Mining Industry and for the Production of Lead and Zinc employed last year 1867 workpeople, and produced 245,074 tons of coal, and a large quantity of lead and zinc; the total value of the company's production last year was 2,6[illegible]6 thalers, as compared with 2,474,928 thalers in 1867. The production of iron rails, &c., in the Aix-la-Chapelle district appears to be considerable.

FOREIGN MINES.

ST. JOHN DEL REY.—Morro Velho, July 29: Morro Velho produce, second division of July, 11 days, 2629 oits.; yield, 1·577 oits. per ton. Produce of Gaia stamps for same period, 358 oits.; yield, 1·283 oits. per ton; remittance, 22,741 oits., equal to 218½ lb. troy.

DON PEDRO.—Mr. F. S. Symons, Aug. 1: Cleared to date, 13,214 oits.; estimate for July, 15,000 oits.; remittance, 29,025 oits. I am pleased to report that the box work has been taken from the bottom stopes in the curve, also from canoa in the underlie lode. The sump shaft is a trifle harder than when last commented on, but auriferous. The sinking east on the new lode is progressing, and I have little alteration to report, although samples in the last few days have not been quite so good. The water is very quick, but we are keeping it under by our present pumping arrangements, and we are pushing on with all speed the work in connection with the horse-engine, nearly all of which is now here. The general stopes have yielded fairly. We have encountered a channel of bad ground in Treloar's level, and I have been under the necessity of suspending the deep adit for a time, and transferring force to Treloar's, so as to get through it as quickly as possible. So long as bad ground continues we shall drive a smaller level and then re-open. Vivian's shaft and Bryant's cross-cut have progressed.—Force: Attendance has been fair, but more hands are essential, as owing to want of them our exploratory works are not being pushed on with as much speed as desirable.

ANGLO-BRAZILIAN.—Mr. F. S. Symons, August 1: Remittance, 4955 oits. General operations have progressed satisfactorily, but little alteration has taken place in appearance of the lodes. Since my last, communication has been made from Foster's east to deep adit. The lode at this section is most promising, as also at Dawson's, but we are suffering from great scarcity of water; never since the company has been working has the supply been so short, and in consequence we are stocking large quantities of stone both in and out of the mine.

ROSSA GRANDE.—Mr. Ernest Hilcke, July 31: Remittance, 1913 oits. Gongo Soco: Western Exploration: The vein has been traced on its regular course for about 20 fathoms west of shaft; beyond this place it is in a very disordered state and requires careful examination. The mining captain, however, thinks that this unsettled state will not extend for any great distance, and is of good hopes that when the vein once again takes its regular course west we shall meet with gold of consequence. So far the vein is poor, and shows only occasionally a few particles of gold.—Mina de Serra: West of the 40 fm. level three small branches of lody matter have come in, which have a tendency that the new shoot we expect to meet here is close at hand. The lode in the stopes between the 30 and 40 fathom level is worked away, and operation concluded here. The eastern end of the 50 fm. level is poor at present; it has been holed to the old stopes opened below the 40 fm. level; however, below this point an apparently good sized lode is left, which will soon be intersected by the new level, called the 56 fm. level; the lode in this level is from 4 to 5 feet wide, and from this section we at present derive our main supply of stone.—Bahu Mine: Not having had any increase of water we have been able to continue our operations in the old workings, and commence driving a cross-cut south at the deepest point for further exploration.

FRONTINO AND BOLIVIA.—The directors have received from their agents at Santa Maria a remittance of abont 720 ozs. of gold, produce for the month of June last, and largest yet received from the company's mines. Owing to the letters from the interior not reaching the coast in time for the mail steamer the usual advices have not yet been received, but are expected about the middle of next month.

TAQUARIL (Gold).—Mr. T. S. Treloar, July 30: Mine: The works are progressing very satisfactorily. Timbering the shallow adit has been completed as far as the engine-shaft, and securing the latter towards the surface commenced. A small side level is now being driven in the neighbourhood of the plat to facilitate landing the kibbles, when operations are resumed below the horizon of this adit. Rouse's level is advancing apace, and provided the ground retains its present favourable nature will, we expect, reach the shaft for rods in about two months more. At the deep adit the ground has again undergone a change, and we are unable to proceed without timber; fair progress, however, is being made.—Surface Works: A large force is employed excavating for the wheel-race, but the work is not proceeding with the rapidity I could wish. The ground is wet in the bottom, and enormous rocks are constantly being encountered. The canal for outlet of water and timber, and iron work pertaining to wheel and flat-rods are progressing well. The houses for accommodation of Blacks are in an advanced state, and the one for Englishmen will be turned out of hand in the course of two or three days.—Force: The attendance of natives is regular, and we have received an addition to our force of Blacks.

SAO VICENTE.—August 1: During the month we have had no rain, consequently our water-power has greatly diminished; so much so that we have not been able to work the stamps. We hastened on the works at the rego, referred to in my last, and are now experiencing the benefit of the additional stream, and I am in hopes with this help we shall have water to keep the pumping wheel in constant work. The mine works are progressing with regularity, and a good pile of stuff is being accumulated. There appeared in the bottom of Phillips' shaft (rock formation) on the 26th a line somewhat larger than we have had for some time, but is at present very poor.—Jacotinga Formation: The end of Smith's cross-cut has been gradually getting harder since my last, and is at present very tight and troublesome for driving. We have set it by contract to a party of six men, in order to have it pushed on.—Mine: Phillips' Shaft: In sinking, as requested, we have gained somewhat to the north. We purpose now to extend a little on the line lately cut in the bottom, to ascertain whether it will open out or improve.

CAPULA.—Capt. Paull, July 27: San Cayetano Hacienda: Torta No 6 is not yet washed, it has been in beneficio much longer than any former one, on account (they say) of the heavy rains; the azogueric sent me a letter on Saturday to say it will be washed this week, but not in time to send the silver by this week's conducta. We have sent to the hacienda during this month 304 cargas (40 tons 14 cwts.), 132 cargas of rough and 172 of smalls, sufficient for tortas Nos. 7 and 8, of 15 montones each, and there are 12 cargas 4 arr. towards torta No. 9. We have in the ore yards about 250 cargas of good ley ore, and about the same quantity of metal from 6 to 9 mares per montone (or 36 to 54 ozs. to the ton).—The Mine: We have commenced opening the plot in the west end of the shaft, from which we shall drive the cross-cut north to intersect the main lode. Price 80s. per vara. San Jorge rise is now up to 40 varas above the Esperanza level. The lode is still producing good azogue ore, but not so good as it has been; the metal has continued up higher than I expected. We are very near to the level of the old workings from La Bomba shaft. The stopes, Nos. 1, 2, and 3, each end of the rise, are without much alteration; the lode is very variable. Last week we raised about 500 castales (13 tons 8 cwts.), leaving two good stopes idle for want of room in the pepena to dress the ore. The ground in the level driving west from La Bomba is very hard, and they do not drive over three-quarter varas weekly. The branch of ore is narrow, but of very good quality. We wish to push this end, as the air is rather bad in the rise.

WEST CANADA.—F. Williams, Aug. 14: Huron Copper Bay: The stope in bottom of the 20, east of Stephen's winze, yields on an average 2 tons of ore per fathom. The lode at this point still continues to fall off in value as we approach the 35, and this poor shift of ground appears to be dipping east. The stope in the 20, west of Palmer's, is not so valuable as when last reported on, but now yields 2 tons of ore per fathom. The stope in bottom of the 20 east yields 3 tons. The stope in bottom of the 35, east of shaft, still looks well, and gives 3 tons. The stope east and west of Powell's winze, on the Fire lode, yields 2 tons of ore per fm. We have suspended this stope for the time being, and have put the men to drive west on a very good lode of ore, that is dipping west through ground that was unproductive above this. Should this ore ground continue to make good up to the point where this lode forms a junction with the new lode it will be a valuable addition to this stope. The stope over the 35, east of Bray's engine-shaft, still looks well, and yields over 3 tons of ore per fm. The stope in bottom of the 35, east of Bartle's winze, yields 2½ tons of ore per fm.; the lode at this point is exceedingly promising, and we are hoping that the ground to the east and west of this winze will prove to be a good paying ground for stoping. The lode in the 60, west of Bray's engine-shaft, is much larger than formerly, and yields some good stones of ore, but not enough to value.—Wellington Mine: The stope east of Rowe's shaft never looked better than it does at the present time, and yields over 3 tons of ore per fathom. The stope west of this shaft yields 2½ tons of ore per fathom.

[For remainder of Foreign Mines, see this day's Journal.]

LONDON GENERAL OMNIBUS COMPANY.—The traffic receipts for the week ending Aug. 29 was 10,844*l*. 15s. 1d.

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